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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Sung-hee HWANG et al.

Application No.: 10/806,347 Group Art Unit:

Filed: March 23, 2004 Examiner:

For: METHOD OF OVERWRITING DATA IN WRITE-ONCE INFORMATION STORAGE MEDIUM AND DATA RECORDING AND/OR REPRODUCING APPARATUS FOR WRITE-ONCE INFORMATION STORAGE MEDIUM

SUBMISSION OF ENGLISH LANGUAGE TRANSLATION OF PRIOR FILED COPENDING PROVISIONAL APPLICATION AND STATEMENT THAT TRANSLATION IS ACCURATE IN ACCORDANCE WITH THE REQUIREMENTS OF 37 C.F.R. § 1.78

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 1.78, the applicants submit herewith a translation of U.S. Provisional Application No. 60/473,894 filed May 29, 2003 and a statement that the translation is accurate.

It is respectfully requested that the applicants be given the benefit of the filing date of the Provisional Application 60/473,894 in accordance with the requirements of 35 U.S.C. § 119.

Respectfully submitted,

STAAS & HALSEY LLP

Date: 6/21/04

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IN THE MATTER OF

U.S. Provisional Application No. **60/473,894**

By Samsung Electronics Co., Ltd

I, So-hee Kim, an employee of Y.P.LE, MOCK & PARTNERS of The Cheonghwa Bldg., 1571-18 Seocho-dong, Seocho-gu, Seoul, Republic of Korea, hereby declare that I am familiar with the Korean and English language and that I am the translator of U.S. Provisional Application and certify that the following is to the best of my knowledge and belief a true and correct translation.

Signed this 7th day of April 2004

Sohee Kim

ABSTRACT

[Abstract of the Disclosure]

A method of realizing an overwriting function in a write-once information storage medium is provided. In the method, first, a command to record data in an area, where data has already been recorded, of the write-once information storage medium is received. Then, the data is recorded in an area of the write-once information storage medium other than the area where data has already been recorded. Thereafter, the area where data has already been recorded is processed as a defective area. According to the method, data recorded in the write-once information storage medium can be changed, and accordingly, users can use the write-once information storage medium to achieve various purposes.

SPECIFICATION

[Title of the Invention]

Method of realizing an overwriting function in write-once information storage medium

[Cross Reference to Related Application]

This application is related to U.S. Provisional Application No. 60/456,559, filed on March 24, 2003, in the United States Patent and Trademark Office, the disclosure of which is incorporated herein in its entirety by reference.

[Brief Description of the Drawings]

FIG. 1 shows a write-once disk according to an embodiment of the present invention;

FIG. 2 shows a write-once disk according to another embodiment of the present invention; and

FIG. 3 is a block diagram of a recording apparatus according to an embodiment of the present invention.

[Detailed Description of the Invention]

[Object of the Invention]

[Technical field of the Invention and Prior art belonging to the Field]

The present invention relates to the field of write-once information storage media, and more particularly, to a method of realizing an overwriting function in a write-once information storage medium.

Write-once information storage media, for example, write-once disks, can write information only one time in a data recording area. Because of this characteristic, write-once information storage media have a lot of limits, such as, a limit in that once information is recorded on a write-once disk, users cannot change the recorded information.

[Technical goal of the Invention]

The present invention provides a method of realizing an overwriting function in a write-once information storage medium so that users can use the write-once information storage medium to achieve a variety of purposes.

[Structure of the Invention]

According to an aspect of the invention, there is provided a method of realizing an overwriting function in a write-once information storage medium. In the method, a command is received to record data in an area, where data has already been recorded, of the write-once information storage medium. Then, the data is recorded in an area of the write-once information storage medium other than the area where data has already been recorded. Thereafter, the area where data has already been recorded is processed as a defective area.

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

FIG. 1 shows a write-once disk according to an embodiment of the present invention. Referring to FIG. 1, an area for recording both a temporary disc defect structure (TDDS) and a space bit map (SBM) is formed in a lead-in zone. A temporary defect list (TDFL) area is also formed in the lead-in zone. In a data area, spare areas 1 and 2 allocated to manage temporary disc defects are formed in areas of predetermined sizes at its head and rear, respectively.

Although not shown in FIG. 1, instead of being formed in the lead-in zone, the area for recording both the TDDS and the SBM may be formed in at least one of a lead-out zone and the data area. In recording media having a plurality of recording layers, each of the layers can have the above-described structure. In the recording media having a plurality of recording layers, when there is no recording space for updated information left in a recording layer, the updated information can be recorded in the next recording layer.

FIG. 2 shows a write-once disk according to another embodiment of the present invention. Referring to FIG. 2 a temporary disc management area (TDMA) and an SBM area are separately formed in a lead-in zone of the write-once disk. In a data area, spare areas 1 and 2 allocated to manage temporary disc defects are formed in areas of predetermined sizes at its head and rear, respectively.

A disc defect management (or temporary disc defect management), spare areas allocated for disc defect management (or temporary disc defect management), and an SBM will now be described in detail.

Disc defect management denotes an operation in which, if a defect is generated in the user data recorded in a user data area, the user data is re-recorded to compensate for the data lost due to the generated defect.

Disc defect management is roughly classified as disc defect management using a linear replacement technique or disc defect management using a slipping replacement technique. In a linear replacement technique, if a defect is generated in the user data area, the defective area is replaced by a non-defective spare area formed in the data area. In a slipping replacement technique, a defective area is not used by being slipped, and a non-defective area is sequentially used.

The linear replacement technique and the slipping replacement technique have been generally applied to discs that can record data several times in a random accessing method, such as, DVD-RAM/RW.

Since the write-once disc of FIG. 1 uses the linear replacement technique, spare areas are formed in the data area as shown in FIG. 1.

When a disk is loaded on a disk drive, the disk drive reads out information stored in the lead-in and/or lead-out zones and ascertains how to manage the disk and how to record or reproduce data on the disk. As the amount of information recorded in the lead-in and/or lead-out zones increases, it takes longer to prepare for data recording or reproduction after the disk has been loaded. Accordingly, the embodiment of the present invention of FIG. 1 introduces the concepts of temporary management data, that is, TDDS and TDFL, and they are recorded in a temporary defect management area that is separate from the defect management areas (DMAs) in the lead-in and/or lead-out zones.

In write-once recording media, a temporary defect management area stores a TDDS and a TDFL.

The temporary defect management area is the general term for a TDDS area and a TDFL area and does not indicate that both a TDDS and a TDFL must be recorded in one area. Of course, the TDDS and TDFL can be recorded in one area or in one cluster. Alternatively, the TDDS and TDFL can be recorded in different clusters of one area or in different clusters of different areas. The TDDS and TDFL can be recorded in one cluster, together with an SBM or disc & drive data. In an

embodiment of FIG. 2, the TDDS and the TDFL are recorded in one area, that is, in a temporary defect management area.

The TDDS area and the TDFL area are formed in at least one of the lead-in zone, the lead-out zone, and the data area. Data security is implemented by repeatedly recording identical data in one area or in a plurality of areas.

The TDDS can include a TDDS recognizer, an update counter, data about the location where a final TDFL has been recorded, data about the location where final disc & drive data has been recorded, and data about the size of a spare area to replace a defective cluster. Because the TDDS includes the data about the locations of disc & drive data and a TDFL, when the TDDS is recorded in a cluster separate from a cluster for a TDFL, the disc & drive data and the TDFL are first recorded, and then the TDDS must be recorded in a TDDS area, including data about the locations where the disc & drive data and the TDFL have been recorded. Also, although the locations where the disc & drive data and the TDFL are to be recorded are predetermined, the two data can be recorded in locations other than the predetermined locations if an error occurs in the predetermined locations where the two data have been recorded.

The TDFL can include a TDFL recognizer, an update counter, the number of defect factors, and the defect factors. The defect factors include state data, data about the locations of defective clusters, and data about the locations of substitute clusters. The state data can be the types of defects or substitute data. The types of defects may include defective clusters necessary to be replaced, defective clusters unnecessary to be replaced, and clusters that may become defective.

The write-once disks according to the above-described embodiments of the present invention store an SBM which represents whether recordable areas on the entire disk have already been used to store data. In the SBM, if data has been recorded in a recordable cluster of the lead-in and lead-out zones and the data area, the value of a bit corresponding to the recordable cluster is represented as 1. If not, the value of a bit corresponding to the recordable cluster is represented as 0.

In write-once recording media, the location of updated data changes with data updating. Hence, write-once recording media check the location changes from the SBM and provide a finally-updated location to disk drives so that the disk drives can quickly access the finally-updated location.

When considering the characteristics of the SBM, it is preferable to form an SBM area in the lead-in or lead-out zone. The TDDS or the TDFL is updated only when a defect is generated. However, the SBM must be updated if some data is recorded in a recordable area and changes the state of the entire disk, although no defects are generated. Hence, the SBM area is more frequently updated than the other area, and accordingly, forming the SBM area in the data area is also considerable.

If a user does not use the SBM, the SBM area can be used as a user data area, thus increasing the usable area of the disk. Besides, the SBM can be recorded in one cluster, together with other data. For example, the SBM can be recorded together with the TDDS in one cluster. Alternatively, the SBM can be recorded together with the TDDS and the TDFL or together with disc & drive data in one cluster.

If the size of a cluster, which is an error correction code (ECC) unit, is 64Kbytes, an SBM of about 32Gbytes can be recorded in one cluster. If the recording capacity of a recording layer in high-density disks following DVDs is about 25Gbytes, it is preferable that an SPM, that is, data about each recording layer, is recorded in one cluster. In other words, in disks with a single recording layer, data about the single recording layer is recorded in one cluster. In disks with a double recording layer, the data about the two recording layers are recorded in two clusters.

As described above, because an SBM represents whether the individual clusters of a recordable area on a disk contain recorded data, the SBM must be updated after data has been recorded in a recordable area, including data about the final disk state and data about the location where the SBM itself is to be recorded.

Two embodiments of a method of realizing an overwriting function in the write-once disks according to the two preferred embodiments of the present invention will now be described.

In a method according to a first embodiment of the present invention, a write-once disk can perform an overwriting function by managing defects as follows. In response to a command from a host to reproduce data from logical addresses 0h through FFh (physical addresses 100h through 1FFh), a drive searches for the physical addresses 100h through 1FFh corresponding to the local addresses 0h through FFh, reproduces data from the physical addresses 100h through 1FFh, and transmits the reproduced data to the host. If the host corrects the received data or

adds new data thereto and then orders a command to the drive to re-record the corrected data in the logical address 0h through FFh, first, the drive determines whether the physical addresses 100h through 1FFh corresponding to the logical address 0h through FFh contain recorded data, by referring to an SBM which represents as bit values whether data have been recorded in each of the clusters of a physical recordable area on a disk. If the physical addresses 100h through 1FFh contain recorded data, they are considered defective, and the corrected data received from the host is recorded in substitute addresses F00h through FFFh of a recordable spare area. Alternatively, although the SBM is not used, defect management is performed during inspection after data recording, and information regarding the defect management is recorded in a temporary defect management area or in a defect management area. Later, if the host requests the logical addresses 0h through FFh, the drive searches for the physical addresses F00h through FFFh, where contain recorded data, corresponding to the requested local addresses 0h through FFh using the recorded defect management information, reproduces the data recorded in the physical addresses F00h through FFFh, and transmits the reproduced data to the host. In this case, to realize an overwriting function in a write-once disk, the defect management information is updated without need to changing a separate volume space by a file system, and accordingly, updated data can be reproduced using the updated defect management data.

When the data has been recorded in a spare area by an overwriting operation achieved by defect management, or when the data has been replaced by defect management by the drive due to a defect occurring at a recording point of time and recorded in a spare area, if the logical addresses 0h through FFh are used upon overwriting, their corresponding physical addresses are 100h through 1FFh, and their substitute addresses are F00h through FFFh, the drive overwrites the data by recording the physical addresses 100h through 1FFh in other substitute recordable addresses 1000h through 10FFh, deleting the recorded defect management information, and producing new defect management information. The new defect management information includes the defective addresses 100h through 1FFh and the substitute addresses 1000h through 10FFh.

Upon defect management, the consecutively-defective physical addresses 100h through 1FFh are represented using both defect data representing the start of

the generated defect and defect data representing the end of the generated defect and recorded in the temporary defect management area.

To be more specific, the defect data includes a plurality of defect factors, such as, state data, the addresses of defective clusters, and the addresses of substitute clusters. If a series of defects are generated, they are represented by both a start defect factor, which is comprised of state data, the address of the first defective cluster, and the address of a substitute cluster corresponding to the first defective cluster, and an end defect factor, which is comprised of state data, the address of the last defective cluster, and the address of a substitute cluster corresponding to the last defective cluster. In this way, the temporary defect management area can be efficiently used.

In the method of the first embodiment according to the present invention, an overwriting function can be realized in a write-once disk while keeping the recording capacity of user data constant.

A method according to a second embodiment of the present invention of realizing an overwriting function in a write-once information storage medium will now be described in detail.

In this method, an overwriting function is realized by a file system in a write-once disk. To be more specific, in response to a command from a host to reproduce data from logical addresses 0h through FFh (physical addresses 100h through 1FFh), a drive searches for the physical addresses 100h through 1FFh corresponding to the local addresses 0h through FFh, reproduces data from the physical addresses 100h through 1FFh, and transmits the reproduced data to the host. If the host corrects the received data or adds new data thereto and then wants to overwrite the corrected data in the logical address 0h through FFh, first, the drive checks whether the user data area of a disk contains recorded data and whether the user data area can store data, by referring to an SBM, which represents as bit values whether each of the clusters of a recordable physical area on the disk, and defect data, and then transmits checked data to the host. The host compares the logical data allocation states of the user data area and the physical recording or recordable states of the user data area and distinguishes a data recordable area from a data unrecordable area. Accordingly, the host itself can select an area where the data is to be overwritten, and thus, an overwriting function is realized in a write-once disk. If the logical addresses 100h through 1FFh (physical addresses

200h through 2FFh) are recordable, and the host issues a command to the drive to record data therein, the drive searches for the physical addresses 200h through 2FFh corresponding to the logical addresses 100h through 1FFh and records the data received from the host in the found physical addresses 200h through 2FFh. In this way, an overwriting function is realized in the write-once disk. In the second embodiment, it is preferable that the entire volume space is changed by a file system.

Before overwriting, to prevent a problem from occurring upon later reproduction/recording of data from/to the local addresses 0h through FFh, they can be processed in the following ways. In a first way, it is indicated on the volume space of the file system that the local addresses 0h through FFh are unrecordable. In a second way, the physical addresses corresponding to the local addresses 0h through FFh are processed as defective areas that have no substitute clusters. In a third way, both the first and second ways can be applied to the local addresses 0h through FFh.

In write-once disks where defect management by a drive is not performed, if the first way was not executed and the host wants to record data, the host recognizes the local addresses 0h through FFh as recordable from the volume space. Hence, the host orders the drive to record data in the local addresses, and the drive unnecessarily informs the host through an SBM that the physical addresses corresponding to the local addresses contain recorded data. Alternatively, data is recorded in the physical addresses without knowing that data has already been recorded in them. Accordingly, data loss may occur.

In a write-once disk whose defects are managed by a drive, if the first way was not executed, a host orders the drive to record data in the logical addresses 0h through FFh. The drive recognizes from an SBM or through the second way that data has already been recorded in the physical addresses corresponding to the logical addresses 0h through FFh, and accordingly records the data in substitute addresses of a spare area according to defect management. However, if the write-once disk includes neither an SBM nor perform the second way, the drive receives a command from the host to record data in the local addresses 0h through FFh and records the data in the physical addresses corresponding to the local addresses 0h through FFh where data has already been recorded once. Thus, data loss inevitably occurs.

The drive provides information about the physical recording state of a user data area to the host in order to prevent the host from issuing a command to record data in areas of the disk where data cannot be recorded. Thereafter, if the host wants the over-written data, the host would request the data stored in the logical addresses 100h through 1FFh because the logical addresses in which the over-written data have been recorded are actually the logical addresses 100h through 1FFh. The drive searches for the physical addresses 200h through 2FFh corresponding to the logical addresses 100h through 1FFh, reproduces data from the physical addresses 200h through 2FFh, and transmits the data to the host. If the area corresponding to the physical addresses 100h through 1FFh is overwritten and then undergoes defect management, generated consecutive defects must be defects having no substitute clusters and are represented using defect factors representing the start and end of the consecutive defects so that the area can be efficiently used. A consecutive defect factor includes the defect factors representing the start and the end of continuous defects. The start defect factor and the end defect factor have the same structure, as in the case of defect factors for defects having substitute clusters. However, because there are no substitute clusters, specific values recognizable by the drive are recorded in the addresses of substitute clusters to prevent the possibility of malfunction. Also, state data can indicate that the continuous defect factor is a defect factor having no substitute clusters.

The second way is suitable for the case where many overwriting operations are performed because of a large data storage capacity of a user data area.

The first way maintains the capacity of a user data area constant without changing the volume space of the file system by an overwriting ability. On the other hand, the second way changes the volume space of the file system using an overwriting ability but provides as many overwriting opportunities as possible by using the large data storage space of a user data area.

The overwriting ability can also be realized using the third way, which is a combination of the first and second ways. Although the drive provides data necessary for overwriting to the host according to the second way, if the host orders a command to the drive to re-record data in the same local addresses, the drive can realize an overwriting function by performing defect management.

FIG. 3 is a block diagram of a recording apparatus according to an embodiment of the present invention. Referring to FIG. 3, the recording apparatus includes a recording/reading unit 1, a controller 2, and a memory 3. The recording/reading unit 1 records data on a disc 100, which is an embodiment of an information storage medium of the present invention, and reads the data from the disc 100 so as to verify the accuracy of the recorded data. The controller 2 performs defect management according to the present invention as set forth in FIGS. 1 through 8.

While not required in all aspects, it is understood that the controller 2 can be computer implementing the method using a computer program encoded on a computer readable medium. The computer can be implemented as a chip having firmware, or can be a general or special purpose computer programmable to perform the method.

In addition, it is understood that, in order to achieve a recording capacity of several dozen gigabytes, the recording and/or reproducing unit 1 could include a low wavelength, high numerical aperture type unit usable to record dozens of gigabytes of data on the disc 100. Examples of such units include, but are not limited to, those units using light wavelengths of 405nm and having numerical apertures of 0.85, those units compatible with Blu-ray discs, and/or those units compatible with Advanced Optical Discs (AOD). Examples of other write once discs include CD-R and DVD-R.

While described in terms of a write-once disc, it is understood that the method can be used with rewritable media or where the medium has write-once and rewritable portions.

[Effect of the Invention]

As described above, in a method of realizing an overwriting function in a write-once information storage medium according to the present invention, data recorded in the write-once information storage medium can be updated. Thus, users can use the write-once information storage medium to achieve various purposes.

What is claimed is:

1. A method of realizing an overwriting function in a write-once information storage medium, the method comprising:

(a) receiving a command to record data in an area of the write-once information storage medium, the area where data has already been recorded;

(b) recording the data in an area of the write-once information storage medium other than the area where data has already been recorded; and

(c) processing as a defective area the area where data has already been recorded.

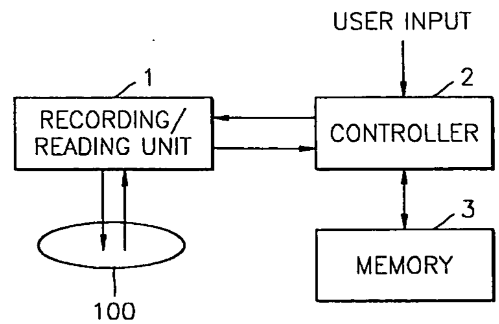
FIG. 1

LEAD_IN ZONE	• • •
	DEFECT MANAGEMENT AREA (DMA 2)
	RECORDING CONDITION TEST AREA
	AREA FOR TEMPORARY DISC DEFECT STRUCTURE AND SPACE BIT MAP (TDDS+SBM)
	TEMPORARY DEFECT LIST (TDFL) AREA
	DISC AND DRIVE INFORMATION AREA
	DEFECT MANAGEMENT AREA (DMA 1)
	• • •
DATA AREA	SPARE AREA 1
	USER DATA AREA
	SPARE AREA 2
LEAD_OUT ZONE	• • •
	DEFECT MANAGEMENT AREA (DMA 4)
	• • •
	DEFECT MANAGEMENT AREA (DMA 3)
	• • •

FIG. 2

LEAD_IN ZONE	...
	DEFECT MANAGEMENT AREA (DMA 2)
	RECORDING CONDITION TEST AREA
	TEMPORARY DEFECT MANAGEMENT AREA
	SPACE BIT MAP AREA
	DISC AND DRIVE DATA AREA
	DEFECT MANAGEMENT AREA (DMA 1)
	...
DATA AREA	SPARE AREA 1
	USER DATA AREA
	SPARE AREA 2
LEAD_OUT ZONE	...
	DEFECT MANAGEMENT AREA (DMA 4)
	...
	DEFECT MANAGEMENT AREA (DMA 3)
	...

FIG. 3


USER INPUT
1
RECORDING/
READING UNIT
2
CONTROLLER
3
MEMORY
100